

Claims

1. Intramedullary nail with a longitudinal axis (5), a near end (1) with means (8) for coupling to an insertion device and a far end (2) with a tip (7) for insertion into the intramedullary canal of a long bone, said far end (2) being provided with at least two traversing through holes (3) with axes (6), all of said through holes (3) being grouped in said far end (2) within a distance x measured from said tip (7) to the axis (6) of the most distant hole (3); and characterized in that,
 - A) said nail is provided with at least a third through hole (3) with axis (6) in said far end (2) which contains the first and second holes (3); and
 - B) the projection of the hole axis (6) of said through holes (3) in a plane orthogonal to said longitudinal axis (5) is such that at least two of said projected hole axes (6) are at an angle α greater than zero and less than 90° with respect to each other.
2. Intramedullary nail according to claim 1, characterized in that said distance x is equal or smaller than $25d$, preferably equal or smaller than $7d$, d being the diameter of the largest of said holes (3).
3. Intramedullary nail according to claim 1, characterized in that said distance x is equal or smaller than $25d$, preferably equal or smaller than $7d$, d being the mean diameter of said holes (3).

4. Intramedullary nail according to one of the claims 1 - 3, characterized in that at least two of said projected hole axes (6) are at an angle α of $58^\circ \leq \alpha \leq 62^\circ$, preferably of $59^\circ \leq \alpha \leq 61^\circ$.
5. Intramedullary nail according to one of the claims 1 - 3, characterized in that at least two of said projected hole axes (6) are at an angle α of $43^\circ \leq \alpha \leq 47^\circ$, preferably of $44^\circ \leq \alpha \leq 46^\circ$.
6. Intramedullary nail according to one of the claims 1 - 3, characterized in that at least two of said projected hole axes (6) are at an angle α of $35^\circ \leq \alpha \leq 37^\circ$, preferably of $35,5^\circ \leq \alpha \leq 36,5^\circ$.
7. Intramedullary nail according to one of the claims 1 - 3, characterized in that at least two of said projected hole axes (6) are at an angle α of $29^\circ \leq \alpha \leq 31^\circ$, preferably of $29,5^\circ \leq \alpha \leq 30,5^\circ$.
8. Intramedullary nail according to one of the claims 1 to 7, characterized in that a number of $n \geq 4$ holes (3) are grouped in said far end (2) within said distance x .

9. Intramedullary nail according to one of the claims 1 to 8, characterized in that said distance x is smaller than $2(n)(d)$, preferably smaller than $1,8(n)(d)$, d being the diameter of the largest of said holes (3).
10. Intramedullary nail according to claim 9, characterized in that the value for x is smaller than $1,5(n)(d)$, preferably smaller than $1,4(n)(d)$.
11. Intramedullary nail according to one of the claims 1 to 9, characterized in that said distance x is smaller than $2(n)(d)$, preferably smaller than $1,8(n)(d)$, d being the mean diameter of said holes (3).
12. Intramedullary nail according to claim 11, characterized in that the value for x is smaller than $1,5(n)(d)$, preferably smaller than $1,4(n)(d)$.
13. Intramedullary nail according to one of the claims 1 to 12, characterized in that the value of n is 5.
14. Intramedullary nail according to one of the claims 1 to 12, characterized in that the value of n is 6.
15. Intramedullary nail according to one of the claims 1 to 14, characterized in that at least two of said through holes (3) are located in such a way that the geometric hollow cylinders, as defined by said holes (3), intersect with one another.

16. Intramedullary nail according to claim 15, characterized in that said two intersecting through holes (3) have intersecting axes (6).

17. Intramedullary nail according to claim 16, characterized in that said two intersecting through holes (3) are spaced at an angle α of $88^\circ - 92^\circ$.

18. Intramedullary nail according to one of the claims 1 to 17, characterized in that at least one of said through holes (3) is provided with an internal thread.

19. Intramedullary nail according to one of the claims 1 to 18, characterized in that at least part of at least one of said through holes (3) is conical.

20. Intramedullary nail according to one of the claims 15 to 19, characterized in that said two intersecting through holes (3) are located at the same distance (a) from said tip (7).

21. Intramedullary nail according to one of the claims 15 and 20, characterized in that only one of said two holes (3) which intersect both are included in the number n of said holes (3).

22. Intramedullary nail according to one of the claims 1 to 21, characterized in that it has a solid cross-section.

23. Intramedullary nail according to one of the claims 1 to 21, characterized in that has a tubular cross-section.

24. Intramedullary nail according to one of the claims 1 to 23, characterized in that the axes of all holes (3) are located in planes orthogonal to said longitudinal axis (5).

25. Intramedullary nail according to one of the claims 1 to 24, characterized in that the distance (a) between the tip (7) and that through hole (3) which is nearest to said tip (7) is

$$a \leq 5 d$$

whereby d is the diameter of said through hole (3).

26. Intramedullary nail according to claim 25, characterized in that said distance a is $\leq 1,5 d$.

27. Intramedullary nail according to one of the claims 1 to 26, characterized in that a plurality of n through holes (3) are provided whose centres (4) are located at a distance x from said tip (7) which is comprised in the range of

$$1,05 (n) (d) \leq x \leq 3,0 (n) (d)$$

28. Intramedullary nail according to one of the claims 1 to 27, characterized in that a plurality of n through holes (3) are provided whose centres (4) are located at a distance x from said tip (7) which is smaller than $4d + (n-1)(2,2d)$.

29. Intramedullary nail according to one of the claims 1 to 28, characterized in that the distance b between the axes (6) of two adjacent through holes (3) is $b \leq 1.5d$.

30. Assembly with an intramedullary nail according to one of the claims 1 to 29, characterized in that at least two of said holes (3) have axis projections in the orthogonal plane, such that the axis projections are parallel to one another.

31. Assembly with an intramedullary nail according to one of the claims 1 to 30, characterized in that at least two of said holes (3) have axis projections in the orthogonal plane which are at right angles to each other in the orthogonal plane.

32. Assembly with an intramedullary nail according to one of the claims 1 to 31, characterized in that it comprises an interlocking screw which has a major diameter equal or larger than 0,9 times the hole diameter into which it is inserted.

33. Assembly with an intramedullary nail according to claim 32, characterized in that the interlocking screw has a major diameter equal or larger than 0,94, preferably 0,96 times the hole diameter into which it is inserted.